

Wisconsin's 1996 open water sportfishing effort and catch from Lake Michigan and Green Bay.

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Abstract - This paper documents the sport fishery in Wisconsin waters of Lake Michigan and Green Bay in 1996. Unlike naturally reproducing species such as yellow perch and smallmouth bass the salmonid sport fishery was sustained through the continued stocking of rainbow trout (*Oncorhynchus mykiss*), lake trout (*Salvelinus namaycush*), brook trout (*S. fontinalis*), brown trout (*Salmo trutta*), coho salmon (*O. kisutch*), and chinook salmon (*O. tshawytscha*). Fishing effort, catch and catch rates were determined from 1) a stratified random creel survey for launched-boat, pier, shore and stream anglers; 2) a randomized mail survey for moored-boat anglers; and 3) mandatory charter reporting system. Anglers spent an estimated 2,973,036 hours fishing on Lake Michigan or Green Bay in 1996 with boat angler effort at 2,174,394 hours or 73% of the total hours. The estimated harvest of 1,070,888 fish was dominated by yellow perch (524,566) and to a lesser degree chinook salmon (183,254), coho salmon (104,715) and rainbow trout (77,099). The boat fishery, comprised of launched-boat, moored-boat anglers and charter boat anglers dominated the fishery by harvesting an estimated 938,776 fish which was 88.0% of the total fish harvested and was dominated by yellow perch (486,640), chinook (164,471) and coho salmon (100,110) and rainbow trout (64,900). Pier, shore and stream anglers harvested primarily yellow perch, brown and rainbow trout. Overall catch rates were highest for yellow perch at 0.1764 fish/hour and chinook salmon at 0.0616 fish/hour.

Before the 1920s, fish biomass and abundance was dominated by lake whitefish (*Coregonus clupeaformis*), lake trout (*Salvelinus namaycush*), bloater chubs (*C. hoyi*), and yellow perch (*Perca flavescens*). During the 1920s to 1950s, the accidental introductions of several exotic species, including the rainbow smelt (*Osmerus mordax*), sea lamprey (*Petromyzon marinus*) and alewife (*Alosa pseudoharengus*), had a major impact on the fish populations in Lake Michigan. These exotic species, along with a deterioration of spawning habitat and increased commercial fishing pressure, were responsible for the decline in the native fish populations (Hansen *et al.* 1990).

In response to the increasing alewife population and declining Lake Michigan fishery, the Wisconsin Department of Natural Resources (WDNR) in 1963 experimentally introduced 9,000 rainbow trout into several Door Co. tributaries with a twofold purpose: 1) to control or limit the abundant alewife population and 2) to provide a sport fishery. This initial stocking proved to be very successful and expanded to include trouts (*Salmo* spp.), chars (*Salvelinus* spp.) and other pacific salmon (*Oncorhynchus* spp.). The stocking of exotic salmonids provided not only a practical way to control the alewife population but also a valuable sport fishery.

In order to manage the Lake Michigan sport fishery,

assessments must be conducted on both the forage and predator fish stocks. Since 1973, the US Fish and Wildlife Service has conducted fall daytime bottom-trawl surveys in Lake Michigan to estimate the abundance of forage fish. These estimates are based on a series of 10 minute trawl tows along the contour of nine depths at each of seven index stations (Eck 1992). Since 19969, the WDNR has monitored the Lake Michigan sport fishery with a statewide contact creel survey. This provides the WDNR with a continuous record of harvest, harvest rates and biological data of the harvest.

This paper reports the results of the annual survey of anglers fishing the Wisconsin waters of Lake Michigan. Data were collected from anglers at ramps, piers, shores and streams, from moored-boat and charter boat anglers. Estimates were then calculated for fishing effort, catch and catch rates for 1996.

STUDY AREA AND METHODS

Geographical Area

The geographical area of this survey is illustrated in Figure 1. Wisconsin's share of Lake Michigan is second only to Michigan and encompasses 495 miles of shoreline and 25 tributaries. The Wisconsin waters of Lake Michigan include Green Bay and portions of two distinct lake basins (northern and southern). For a complete description see Eggold (1995).

Creel Survey Design

The open water creel survey was conducted using a modified access point design called the Wisconsin Hybrid design. It differs from a true access point design in that creel clerks visit several sites per site group. The fishing season for the creel survey from March 15th to October 31st is stratified by statistical management unit (SMU) (i.e. counties), fishery types (i.e. ramp, pier, shore and stream), statistical survey periods (i.e. months or groups of months) and day type (i.e. weekday, weekend/holiday). Statistical Management Units (SMU) were assigned based primarily on county lines and include units like Kenosha, Racine, Milwaukee, etc. Survey sites within each SMU were placed into site groups. There may be one or several site groups in each SMU based on the time of year and size of each SMU. Site groups were selected randomly on a daily basis

without replacement and survey sites within a site group were visited randomly. Surveys were conducted on every weekend day and holiday and on either two or three days during the week, depending on the month. Each workday was comprised of two shifts, and am and pm shift. Combined together, the two shifts covered the entire angling day. The clerk worked one shift per workday. The shifts were equal in duration, did not overlap and were sampled with equal probability. An example is shown below.

EXAMPLE:

Statistical Management Unit	MILWAUKEE	
Site Groups	MILW. SOUTH	MILW. NORTH
Survey Sites	S. Shore Ramps	McKinley Ramps
	S. Shore Pier	McKinley Pier
	Oak Creek	Milwaukee River
	Grant Park	Riverfront Ramp
	S. Metro Pier	N. City Shoreline

Three types of data were collected for each site sampled: angler, boat trailer or car counts for effort, angler or party interviews for harvest rates and biological information on harvested fish. Instantaneous counts were made by creel clerks at all sites in the survey. The type of count was dependent on the type of fishery. At most ramp sites, boat trailers were counted. At most pier, shore and stream sites, anglers were counted. However, due to poor access points on some tributaries, car counts were used and were corrected by the number of anglers in the car from interview data. The time the count was completed and count per site were recorded on the activity count form.

Angler or angler parties were interviewed at the completion of their fishing trips. Anglers were asked if they were state residents, what time they started their fishing trip, what they fished for and the number of caught and harvested fish. These data were recorded on the angler interview form (Figure 2). If the angler indicated that they had harvested fish, biological information such as species, length, weight, finclip and tag numbers were collected (Figure 3). Standard weight calculations followed that of Hansen (1986).

Fishing effort calculations. Fishing effort estimates (expressed in angler hours) were derived from instantaneous counts of anglers at pier, breakwater, shore and stream sites and from counts of boat trailers

at boat ramps and from counts of cars at stream sites. Counts were made at randomly computed times at each site during each visit. We estimated angler effort and its variance within each stratum (SMU, fishery type, month and day type). The variance of angler effort involves variability among days and variability within days. Formulas for two stage surveys were used to calculate variance. For a complete description see Eggold (1995).

Harvest and harvest rate calculations. Harvest estimates were derived from interviews of anglers at all sites. For each interview, the number of fish harvested and the hours fished were determined. The harvest and hours fished were summed over all interviews in a stratum, the ratio of the sum and the variance of the ratio were then calculated.

For example, for each species, the estimated harvest was calculated using 3 steps: 1) the harvest rate was estimated for the SMU, SSP and day type by dividing total number of fish counted during interviews by the number of angler hours reported in those interviews; 2) the harvest rate was then multiplied by the **total marginal fishing effort** to get the marginal harvest; 3) the marginal harvest was summed across day types to get total estimated harvest. Harvest rates were then calculated by dividing the total estimated harvest by the total number of angling hours. All calculations were made with a verified computer program.

Moored Boat Survey Design

Anglers who moored their boat on Lake Michigan and Green Bay were surveyed by questionnaire beginning in 1988. The earlier surveys (1982-1985) were based on voluntary information from moored-boat owners who received their survey form from sport fishing clubs. However, in 1988, creel clerks were asked to compile a list of boat registration numbers of moored-boats present on Lake Michigan during a day of bad weather. These numbers were used to develop a list of boat owners from the Wisconsin Department of Natural Resources master file of registered boats. Beginning in 1988, a mail survey was sent to all moored-boat owners to obtain information on 1) whether they moored their boat on Lake Michigan or Green Bay; 2) the port of call; 3) whether the boat was used for fishing during that week; 4) the number of days fished; 5) number of anglers in the fishing

party; 6) number of hours fished; and 7) the number of each species caught on each day during the past seven day period.

Fishing effort and harvest calculations. Fishing effort was calculated by harbor and month for each month of the survey. Party size and number of hours fished on each trip were multiplied, summed for each month and harbor, and divided by the number of responses received for the month. This total was multiplied by the boat count and the number of days in the month to obtain estimated angler hours for the entire moored-boat population. Harvest estimates were calculated by harbor and month for each species based on catch per boat. The harvest was summed for each month and harbor, and divided by the number of responses received for the month. This total was multiplied by the boat count and the number of days in the month to obtain estimated harvest for the entire moored-boat population.

Harvest rate calculations. Harvest rate, the number of fish caught per angler hour, was obtained by dividing the monthly reported catch of each species by the total fishing effort for that month for each harbor.

This type of survey is biased because only those interested and successful anglers tend to mail back the survey form. Therefore, the harvest will tend to be an overestimate of the actual number but should be comparable among years and locations. For a more detailed description of the calculations and formulas see Eggold (1993).

Charter Boat Survey Design

At the beginning of each fishing season, a packet of information was sent to each licensee. This packet included notes on important fishing items, a sample of a completed monthly report, grid map of Lake Michigan, list of wardens, coded-wire tag collection stations, finclip list, sea lamprey information, a supply of monthly report forms and a supply of steelhead log forms to record tagged fish.

Each license holder was required by law to report all paid charters. The report was to be mailed by the 10th of each month on the records for the preceding calendar month to the Plymouth Field Station of the

WDNR. If a report was late or incorrectly filled out a warning letter was sent. Only one letter was sent per license holder and any subsequent violations were referred directly to a Wisconsin Conservation Warden.

The information obtained from each form included: license number, fishing port, date of fishing trip, grid fished, number of resident and nonresident anglers, number of fish harvested, time each trip started (am, pm, evening), number of lines fished and number of hours fished. This information had to be recorded within half an hour after completing each trip after returning to the dock or shore. The number of lake trout, coho salmon, brown trout, steelhead, chinook salmon and other species caught, tag numbers present and the number of lampreys attached to chinook salmon and lake trout had to be recorded prior to midnight of the day of each trip. The data were received at the Plymouth Field Station, entered and checked for errors.

RESULTS

For purposes of this report both harvest and catch will be used synonymously to mean the number of fish harvested. Fishing effort in Wisconsin waters of Lake Michigan and Green Bay was estimated at 2,973,036 ($\pm 52,708$) hours for 1996 during the open water season from March 1 - December 31 (Table 1). Angler hours decreased slightly from 1995 (3,273,866) and have dropped slightly in each year since 1989 (Figure 4). The Green Bay area had the most fishing effort at 972,938 ($\pm 34,570$) hours or 33% of all angler hours for 1996. Kewaunee Co. had the second highest effort at 334,736 ($\pm 23,955$) hours.

Angler hours were disproportionately spread among the four fishery types. Boat anglers spent 2,174,394 ($\pm 48,139$) hours or 73% of all angler hours fishing on Lake Michigan or Green Bay (Table 4). Stream anglers fished the second most at 418,800 ($\pm 18,444$) hours or 14% of the total (Table 7). Pier and shore anglers fished 167,219 ($\pm 6,999$) and 212,623 ($\pm 8,465$) hours respectively (Tables 5-6).

Fishermen caught an estimated 440,429 ($\pm 10,304$) salmonids during the 1996 season (Table 2). Chinook salmon dominated the catch comprising 183,254 ($\pm 7,746$) fish or 42% of the total representing the highest harvest since 1989. Coho salmon harvest numbers increased to 104,715 ($\pm 4,546$) probably due

to the restoration of the 5/day bag limit in 1996. Rainbow trout harvest dropped from 1995 to 77,099 ($\pm 4,192$) fish or 18% of the total. Rainbow trout was the most numerous species caught in 1993-1994. However, chinook salmon as it did from 1988-1992 and 1995 when it comprised 34% of the salmonid harvest, once again had the highest percentage. Brown trout were the fourth numerous salmonid harvested at 38,093 ($\pm 2,160$) fish followed by lake trout at 36,849 ($\pm 1,806$) and brook trout at 419 (± 112).

The combined catch rate for salmonids are depicted in Table 2 and Figure 5. The catch rate increased considerably in 1996 to 0.1481 fish/hour and was much higher than previous years. This can be attributed to a decrease in angler hours, increase in salmonid harvest especially chinook and coho salmon and improved fishing conditions during the 1996 fishing season.

The total catch of 13 major species was 1,070,888 ($\pm 40,101$) fish for 1996 (Table 3). The majority of the catch came from boat anglers (Table 4) who caught 938,776 ($\pm 38,931$) fish or 88.0% of the total. The other angler types, pier, shore and stream accounted for 22,600 ($\pm 2,136$), 30,917 ($\pm 2,003$) and 78,595 ($\pm 9,159$) fish respectively or 2.1%, 2.9% and 7.3% of the total (Tables 5-7).

Yellow perch comprised the majority of the catch from all areas combined at 524,566 ($\pm 37,406$) fish and had an overall catch rate of 0.1764 fish/hour (Table 3). Yellow perch were also the most numerous species caught for the boat and pier fishery although the majority (92.8%) were caught by boat fishermen (Table 4). Yellow perch catch rates were also highest for the boat fishery at 0.2238 fish/hour followed by the pier fishery at 0.0941 (Table 5). The majority of the harvest took place in the summer months from July to September. Both catch and catch rate declined in 1996 from previous years.

Chinook salmon, for the second year in a row dominated the salmonid harvest during the 1996 fishing season. Anglers caught 183,254 ($\pm 7,746$) chinook salmon up significantly from 1995 and equal to the numbers caught in 1988 and 1989 (Table 2). The overall catch rate of 0.0616 was higher than those calculated for coho salmon and steelhead. Like those two species, the majority of the harvest occurred in the boat fishery with anglers harvesting 164,471 (\pm

7,622) fish or 90% of all chinook salmon caught (Table 4). Boat angler catch rates were 0.0756. Stream anglers harvested 11,107 ($\pm 1,171$) chinook salmon with catch rates at 0.0265 (Table 7). The average weight and length for chinook salmon were 8.0 (± 6.8) pounds and 25.7 (± 7.1) inches, while the standard weight was 9.7 pounds (Table 8). All three parameters declined slightly from 1995.

The coho salmon harvest increased dramatically in 1996 to 104,715 ($\pm 4,546$) fish which was the most caught since 1994 (Table 3). Overall coho salmon catch rates were 0.0352, significantly less than chinook salmon catch rates. Boat anglers harvested 96% of all coho salmon (100,110) and enjoyed catch rates of 0.0460 fish/hour (Table 4). The remaining harvest was divided among the pier, shore and stream anglers at 383, 1,596 and 2,626 fish, respectively (Tables 5-7). Biological data collected on coho salmon showed that the mean weight was 4.6 (± 2.0) pounds and the mean length was 22.6 (± 3.1) inches with a standard weight of 3.9 pounds (Table 8). All three parameters increased in 1996, reversing a 3 year trend of declining averages.

Rainbow trout was the third most abundant salmonid and fourth most abundant species caught in 1996 at 77,099 ($\pm 4,192$) (Table 2-3). Rainbow trout catch rates were the third highest among all salmonids at 0.0259 fish/hour. The majority of the catch occurred in the boat fishery with 64,900 ($\pm 4,085$) fish caught (Table 4). Stream anglers caught 10,577 (± 899) steelhead with catch rates at 0.0253 fish/hour (Table 7). Rainbow trout averaged 6.8 (± 2.9) pounds and 25.9 (± 4.1) inches with a standard weight of 3.9 pounds (Table 8) remaining constant from the previous years.

Anglers in Wisconsin harvested 36,849 ($\pm 1,806$) lake trout in Lake Michigan and Green Bay. While the harvest was fairly high, the overall catch rate was lower than all major salmonids except brook trout at 0.0124 fish/hour (Table 3). Like coho and chinook salmon, boat anglers caught most of the lake trout, catching 36,056 ($\pm 1,750$) fish or 98% of all lake trout. Boat catch rates were slightly higher than the overall catch rate estimated at 0.0166 fish/hour (Table 4). Lake trout size was calculated at 7.5 (± 4.6) pounds and 26.3 (± 4.9) inches with a standard weight of 5.4 pounds (Table 8).

An estimated 38,093 ($\pm 2,160$) brown trout were

harvested in 1996 from all surveyed areas, with an overall catch rate of 0.0128 fish/hour (Table 3). Unlike the other salmonids, which were almost exclusively caught in the boat fishery, brown trout harvest by boat anglers was 21,809 ($\pm 1,764$) fish or only 57% of the total. Pier anglers harvested 3,063 (± 365) brown trout and had catch rates of 0.0183 fish/hour (Table 5). This total was the highest of any species except yellow perch and comprised 14% of the non-yellow perch pier harvest. Likewise, shore anglers caught 10,523 ($\pm 1,141$) brown trout or 34% of the non-yellow perch shore harvest (Table 6). Shore catch rates were 0.0495 fish/hour. Brown trout biological data for 1996 showed that their mean size was 5.5 (± 3.9) pounds, 21.2 (± 4.3) inches and 3.9 pounds standard weight (Table 8).

Smallmouth bass were numerous in the catch, totaling 51,745 ($\pm 4,398$) fish (Table 3). The harvest was highest in June and July. Overall catch rates were 0.0174 fish/hour, much less than those calculated for yellow perch. Again, boat anglers caught the majority of the smallmouth bass, harvesting 47,035 ($\pm 4,308$) fish or 91% of the total (Table 4). Boat catch rates were slightly higher (0.0216) than the overall catch rate. The remainder of the harvest was spread among the three remaining fishery types, having catch rates of 0.0017, 0.0130 and 0.0039 fish/hour respectively (Tables 5-7).

White perch were also numerous in the catch at 30,181 ($\pm 8,476$) much more common in 1996 than in previous years. Overall catch rates were fairly low at 0.0102 fish/hour (Table 3). The majority of the harvest occurred in the stream fishery at 28,474 ($\pm 8,439$) fish representing 94% of the harvest. Stream catch rates were 0.0680 fish/hour the highest among all the species. The remaining fishery types comprised the remainder of the harvest (1,707 fish).

Walleyes were the last species harvested in large numbers during the open water fishing season. An estimated 18,468 ($\pm 3,199$) walleyes were caught with the majority caught in spring and fall (Table 3). Like smallmouth bass, catch rates were lower than most salmonids at 0.0062 fish/hour. The harvest was concentrated exclusively in two fishery types, boat and stream. Boat anglers caught 12,409 ($\pm 3,024$) walleyes (Table 4) while stream anglers caught 5,994 ($\pm 1,041$) walleyes (Table 7). Stream catch rates of 0.0143 fish/hour were better than boat catch rates of 0.0057 fish/hour.

The remaining species, atlantic salmon, brook trout, splake and northern pike comprised only 0.6% of the total harvest and 1% of the non-yellow perch harvest.

SUMMARY

Lake Michigan anglers spent an estimated 2,973,036 hours fishing on Lake Michigan or Green Bay with boat angler effort at 2,174,394 hours or 73% of the total hours. The estimated harvest of 1,070,888 fish was dominated by yellow perch (524,566) and to a lesser degree rainbow trout (77,099) and coho (104,715) and chinook salmon (183,254). The salmonid harvest decreased from 466,943 fish in 1995 to 440,429 fish in 1996 and like previous years (1986-1992) was dominated by chinook salmon. Overall catch rates were slightly higher in 1996, due to the extremely successful chinook salmon and coho salmon fishery exhibited in 1996.

Several factors had major impacts during the 1996 fishing season. The coho salmon bag limit was restored back to 5/day. This action was partially responsible for the 59% increase in coho salmon harvest in 1996. Secondly, weather patterns during late July, August and September were ideal. Large numbers of all species were harvested during this time period. In fact, higher than average catches of coho and chinook salmon occurred in September and October because of the late warm up in 1996. A similar pattern formed in 1995, with both years showing large catches of fish.

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Table 1. Estimated angler effort (hours) by area in Wisconsin waters of Lake Michigan and Green Bay, March-December 1989-1996. Standard deviation in brackets.

Area	1989	1990	1991	1992	1993	1994	1995	1996
Kenosha Co.	247,995 [12,460]	178,036 [10,685]	184,570 [10,815]	196,298 [10,102]	195,609 [9,665]	189,877 [8,195]	164,111 [9,934]	157,607 [6,705]
Racine Co.	347,691 [23,709]	295,553 [20,111]	332,412 [20,585]	411,704 [21,114]	327,379 [19,740]	315,927 [13,911]	335,535 [18,995]	238,052 [13,846]
Milwaukee Co.	491,144 [20,180]	441,728 [16,495]	465,734 [19,160]	491,750 [19,696]	368,467 [13,736]	404,704 [14,303]	343,545 [12,115]	280,704 [9,625]
Ozaukee Co.	305,999 [20,556]	226,882 [12,032]	175,813 [9,630]	211,667 [11,331]	139,075 [8,437]	206,470 [11,873]	232,899 [16,115]	242,963 [11,915]
Sheboygan Co.	322,205 [22,759]	240,318 [11,690]	191,250 [10,632]	211,947 [11,732]	152,770 [8,747]	244,500 [13,999]	249,426 [16,183]	262,948 [14,697]
Manitowoc Co.	355,358 [14,921]	296,175 [12,231]	260,313 [12,589]	303,214 [15,706]	298,533 [15,475]	266,866 [11,121]	235,990 [9,038]	204,487 [9,673]
Kewaunee Co.	377,371 [19,380]	279,385 [15,959]	328,171 [21,383]	295,724 [13,318]	342,852 [17,627]	338,864 [18,617]	329,637 [16,500]	334,736 [23,955]
E. Door Co.	386,737 [24,669]	406,998 [25,043]	344,292 [16,485]	390,178 [38,245]	310,454 [16,293]	331,851 [19,768]	304,201 [17,298]	278,601 [15,113]
Green Bay	1,545,234 [47,909]	1,245,291 [39,981]	1,324,911 [40,786]	1,188,588 [38,041]	1,112,877 [39,002]	1,191,252 [34,804]	1,078,522 [32,379]	972,938 [34,570]
TOTAL	4,379,695 [74,613]	3,610,365 [60,844]	3,607,466 [60,536]	3,701,072 [67,348]	3,248,017 [56,181]	3,490,310 [53,615]	3,273,866 [53,193]	2,973,036 [52,708]

Table 2. Estimated catch and catch rate of salmonids in Wisconsin waters of Lake Michigan and Green Bay, March-December 1989-1996. Standard deviation in brackets.

Species	1989	1990	1991	1992	1993	1994	1995	1996
Coho Salmon	105,223 [3,588]	64,085 [3,002]	44,195 [2,435]	70,876 [3,890]	74,304 [4,151]	110,001 [5,857]	65,647 [3,107]	104,715 [4,546]
Chinook Salmon	188,954 [7,650]	111,342 [4,399]	139,081 [5,318]	103,568 [6,571]	87,366 [3,707]	99,754 [4,424]	162,888 [5,953]	183,254 [7,746]
Rainbow Trout	87,990 [4,088]	51,708 [2,996]	67,878 [3,408]	79,525 [6,029]	104,765 [3,998]	114,774 [4,455]	117,508 [4,416]	77,099 [4,192]
Brown Trout	55,041 [3,579]	45,094 [3,605]	59,164 [4,182]	51,554 [2,794]	64,546 [3,735]	52,398 [2,695]	49,654 [2,630]	38,093 [2,160]
Brook Trout	2,196 [246]	5,928 [616]	1,661 [397]	4,432 [458]	1,967 [311]	7,482 [797]	1,914 [332]	419 [112]
Lake Trout	94,543 [3,414]	75,180 [3,067]	85,842 [3,279]	52,854 [2,504]	60,943 [2,776]	53,989 [2,337]	69,332 [2,797]	36,849 [1,806]
TOTAL	533,946 [10,613]	353,338 [7,753]	397,821 [8,615]	362,809 [10,438]	393,891 [8,290]	438,397 [9,332]	466,943 [8,913]	440,429 [10,304]
Catch Rate	0.1219	0.0979	0.1103	0.0980	0.1213	0.1256	0.1426	0.1481

Table 3. Estimated catch per hour, catch and effort for all survey areas and all fishery types for Wisconsin waters of Lake Michigan and Green Bay in 1996. Standard deviations in brackets.

Species	Total catch per hour	Mar/Apr	May	June	July	August	Sept/Oct	Nov/Dec	Season
Coho salmon	0.0352	172 [81]	16,753 [2,854]	17,280 [1,631]	38,462 [2,591]	20,734 [1,425]	11,218 [1,052]	96 [25]	104,715 [4,546]
Chinook salmon	0.0616	105 [67]	257 [105]	1,091 [217]	44,642 [3,317]	91,081 [6,183]	45,143 [3,273]	935 [51]	183,254 [7,746]
Rainbow trout	0.0259	9,299 [871]	1,844 [323]	3,336 [422]	14,237 [1,104]	19,548 [1,398]	28,544 [3,680]	291 [91]	77,099 [4,192]
Atlantic salmon	0.0000	0 [0]	0 [0]	0 [0]	21 [21]	38 [38]	0 [0]	0 [0]	59 [43]
Brown trout	0.0128	8,991 [1,128]	4,396 [1,084]	1,092 [257]	4,997 [711]	10,223 [911]	8,188 [902]	206 [43]	38,093 [2,160]
Brook trout	0.0001	252 [101]	0 [0]	0 [0]	36 [14]	83 [39]	45 [24]	3 [0]	419 [112]
Lake trout	0.0124	360 [125]	2,429 [626]	5,475 [521]	12,382 [1,047]	12,386 [1,012]	3,710 [679]	107 [0]	36,849 [1,806]
Splake	0.0006	197 [93]	1,365 [782]	0 [0]	22 [22]	0 [0]	80 [58]	0 [0]	1,664 [790]
Northern pike	0.0013	1,435 [458]	536 [201]	0 [0]	183 [148]	1,174 [600]	448 [175]	0 [0]	3,776 [814]
White perch	0.0102	0 [0]	6,005 [3,513]	13,900 [7,116]	7,673 [2,878]	1,868 [494]	735 [585]	0 [0]	30,181 [8,476]
Smallmouth bass	0.0174	75 [75]	7,297 [1,990]	12,842 [1,975]	15,727 [2,429]	9,492 [1,921]	6,312 [1,372]	0 [0]	51,745 [4,398]
Yellow perch	0.1764	8,081 [2,455]	4,365 [1,618]	26,846 [6,062]	113,217 [14,362]	203,631 [24,191]	168,426 [23,715]	0 [0]	524,566 [37,406]
walleye	0.0062	197 [90]	5,220 [1,457]	2,074 [518]	1,270 [426]	5,613 [2,576]	4,094 [1,008]	0 [0]	18,468 [3,199]
TOTAL	0.3602	29,164 [2,886]	50,467 [5,614]	83,936 [9,753]	252,869 [15,525]	375,871 [25,302]	276,943 [24,337]	1,638 [115]	1,070,888 [62,121]
Angler hours		299,432 [23,488]	207,165 [12,860]	334,990 [14,789]	748,181 [28,597]	792,234 [23,380]	582,837 [21,848]	8,197 [777]	2,973,036 [52,708]

Table 4. Estimated catch per hour, catch and effort for the boat fishery with all survey areas combined for Wisconsin waters of Lake Michigan and Green Bay in 1996. Standard deviations in brackets.

Species	Total catch per hour	Mar/Apr	May	June	July	August	Sept/Oct	Nov/Dec	Season
Coho salmon	0.0460	7 [6]	16,703 [2,854]	17,150 [1,630]	38,360 [2,591]	20,487 [1,423]	7,359 [944]	44 [0]	100,110 [4,520]
Chinook salmon	0.0756	105 [67]	257 [105]	1,086 [217]	44,537 [3,317]	89,606 [6,175]	28,092 [2,982]	788 [0]	164,471 [7,622]
Rainbow trout	0.0298	341 [91]	1,069 [286]	2,984 [390]	13,920 [1,011]	19,342 [1,396]	27,186 [3,671]	58 [0]	64,900 [4,085]
Atlantic salmon	0.0000	0 [0]	0 [0]	0 [0]	21 [21]	38 [38]	0 [0]	0 [0]	59 [43]
Brown trout	0.0100	2,639 [529]	3,041 [1,041]	565 [162]	3,947 [688]	7,291 [768]	4,232 [811]	94 [0]	21,809 [1,764]
Brook trout	0.0000	22 [22]	0 [0]	0 [0]	19 [0]	45 [25]	13 [0]	3 [0]	102 [33]
Lake trout	0.0166	360 [125]	2,407 [626]	5,460 [521]	12,249 [1,046]	12,364 [1,012]	3,109 [516]	107 [0]	36,056 [1,750]
Splake	0.0006	171 [90]	1,175 [777]	0 [0]	22 [22]	0 [0]	57 [57]	0 [0]	1,425 [784]
Northern pike	0.0010	498 [245]	203 [116]	0 [0]	183 [148]	1,174 [600]	85 [68]	0 [0]	2,143 [678]
White perch	0.0007	0 [0]	0 [0]	0 [0]	734 [523]	323 [197]	560 [555]	0 [0]	1,617 [788]
Smallmouth bass	0.0216	75 [75]	6,775 [1,974]	12,028 [1,958]	14,825 [2,405]	8,726 [1,875]	4,606 [1,235]	0 [0]	47,035 [4,308]
Yellow perch	0.2238	0 [0]	3,011 [1,460]	23,762 [6,038]	99,666 [14,253]	197,872 [24,171]	162,329 [23,641]	0 [0]	486,640 [37,214]
walleye	0.0057	103 [73]	3,216 [1,216]	1,175 [452]	262 [152]	4,549 [2,552]	3,104 [957]	0 [0]	12,409 [3,024]
TOTAL	0.4317	4,321 [624]	37,857 [4,223]	64,210 [6,606]	228,745 [15,151]	361,817 [25,267]	240,732 [24,204]	1,094 [0]	938,776 [38,931]
Angler hours		93,366 [18,430]	139,997 [11,756]	277,910 [13,616]	647,108 [27,984]	691,153 [22,832]	322,408 [18,699]	2,452 [0]	2,174,394 [48,139]

Table 5. Estimated catch per hour, catch and effort for the pier fishery with all survey areas combined for Wisconsin waters of Lake Michigan and Green Bay in 1996. Standard deviations in brackets.

Species	Total catch per hour	Mar/Apr	May	June	July	August	Sept/Oct	Nov/Dec	Season
Coho salmon	0.0023	13 [13]	0 [0]	22 [21]	102 [55]	176 [55]	70 [50]	0 [0]	383 [95]
Chinook salmon	0.0123	0 [0]	0 [0]	5 [5]	105 [48]	1,148 [200]	802 [173]	0 [0]	2,060 [269]
Rainbow trout	0.0030	6 [6]	17 [17]	5 [5]	259 [72]	135 [64]	86 [42]	0 [0]	508 [107]
Atlantic salmon	0.0000	0 [0]	0 [0]	0 [0]	0 [0]	0 [0]	0 [0]	0 [0]	0 [0]
Brown trout	0.0183	186 [81]	745 [197]	306 [136]	607 [126]	876 [200]	343 [115]	0 [0]	3,063 [365]
Brook trout	0.0003	0 [0]	0 [0]	0 [0]	14 [14]	28 [28]	0 [0]	0 [0]	42 [32]
Lake trout	0.0010	0 [0]	14 [14]	15 [15]	133 [52]	0 [0]	0 [0]	0 [0]	162 [56]
Splake	0.0013	26 [26]	190 [89]	0 [0]	0 [0]	0 [0]	0 [0]	0 [0]	216 [92]
Northern pike	0.0003	0 [0]	49 [33]	0 [0]	0 [0]	0 [0]	0 [0]	0 [0]	49 [33]
White perch	0.0005	0 [0]	0 [0]	0 [0]	0 [0]	79 [79]	0 [0]	0 [0]	79 [79]
Smallmouth bass	0.0017	0 [0]	60 [39]	68 [64]	141 [76]	0 [0]	22 [22]	0 [0]	291 [109]
Yellow perch	0.0941	2,447 [1,209]	330 [135]	884 [512]	8,299 [1,446]	3,299 [662]	482 [182]	0 [0]	15,741 [2,074]
Walleye	0.0000	0 [0]	0 [0]	6 [5]	0 [0]	0 [0]	0 [0]	0 [0]	6 [5]
TOTAL	0.1352	2,678 [1,212]	1,405 [260]	1,311 [534]	9,660 [1,458]	5,741 [730]	1,805 [285]	0 [0]	22,600 [2,136]
Angler hours		9,165 [1,940]	15,206 [2,124]	13,395 [1,179]	45,279 [3,512]	47,246 [2,997]	36,928 [4,244]	0 [0]	167,219 [6,999]

Table 6. Estimated catch per hour, catch and effort for the shore fishery with all survey areas combined for Wisconsin waters of Lake Michigan and Green Bay in 1996. Standard deviations in brackets.

Species	Total catch per hour	Mar/Apr	May	June	July	August	Sept/Oct	Nov/Dec	Season
Coho salmon	0.0075	152 [79]	50 [36]	108 [46]	0 [0]	71 [55]	1,215 [230]	0 [0]	1,596 [256]
Chinook salmon	0.0264	0 [0]	0 [0]	0 [0]	0 [0]	327 [228]	5,289 [649]	0 [0]	5,616 [688]
Rainbow trout	0.0052	766 [244]	47 [25]	16 [16]	58 [31]	71 [31]	156 [49]	0 [0]	1,114 [255]
Atlantic salmon	0.0000	0 [0]	0 [0]	0 [0]	0 [0]	0 [0]	0 [0]	0 [0]	0 [0]
Brown trout	0.0495	5,475 [975]	569 [223]	221 [146]	443 [128]	2,056 [448]	1,759 [249]	0 [0]	10,523 [1,141]
Brook trout	0.0009	183 [95]	0 [0]	0 [0]	3 [2]	10 [10]	0 [0]	0 [0]	196 [96]
Lake trout	0.0030	0 [0]	8 [8]	0 [0]	0 [0]	22 [22]	601 [441]	0 [0]	631 [442]
Splake	0.0001	0 [0]	0 [0]	0 [0]	0 [0]	0 [0]	14 [10]	0 [0]	14 [10]
Northern pike	0.0008	4 [4]	0 [0]	0 [0]	0 [0]	0 [0]	160 [66]	0 [0]	164 [66]
White perch	0.0001	0 [0]	0 [0]	0 [0]	0 [0]	11 [11]	0 [0]	0 [0]	11 [11]
Smallmouth bass	0.0130	0 [0]	189 [153]	225 [122]	729 [328]	287 [287]	1,339 [569]	0 [0]	2,769 [743]
Yellow perch	0.0387	0 [0]	315 [197]	0 [0]	5,181 [1,021]	1,862 [510]	866 [27]	0 [0]	8,224 [1,159]
walleye	0.0003	0 [0]	0 [0]	0 [0]	59 [59]	0 [0]	0 [0]	0 [0]	59 [59]
TOTAL	0.1454	6,580 [1,013]	1,178 [337]	570 [196]	6,473 [1,082]	4,717 [775]	11,399 [1,030]	0 [0]	30,917 [2,003]
Angler hours		38,050 [4,190]	15,264 [1,176]	12,876 [1,442]	30,484 [2,362]	35,073 [3,306]	80,876 [5,841]	0 [0]	212,623 [8,465]

Table 7. Estimated catch per hour, catch and effort for the stream fishery with all survey areas combined for Wisconsin waters of Lake Michigan and Green Bay in 1996. Standard deviations in brackets.

Species	Total catch per hour	Mar/Apr	May	June	July	August	Sept/Oct	Nov/Dec	Season
Coho salmon	0.0063	0 [0]	0 [0]	0 [0]	0 [0]	0 [0]	2,574 [400]	52 [25]	2,626 [400]
Chinook salmon	0.0265	0 [0]	0 [0]	0 [0]	0 [0]	0 [0]	10,960 [1,170]	147 [51]	11,107 [1,171]
Rainbow trout	0.0253	8,186 [831]	711 [148]	331 [162]	0 [0]	0 [0]	1,116 [245]	233 [91]	10,577 [899]
Atlantic salmon	0.0000	0 [0]	0 [0]	0 [0]	0 [0]	0 [0]	0 [0]	0 [0]	0 [0]
Brown trout	0.0064	691 [187]	41 [38]	0 [0]	0 [0]	0 [0]	1,854 [283]	112 [43]	2,698 [344]
Brook trout	0.0002	47 [26]	0 [0]	0 [0]	0 [0]	0 [0]	32 [24]	0 [0]	79 [35]
Lake trout	0.0000	0 [0]	0 [0]	0 [0]	0 [0]	0 [0]	0 [0]	0 [0]	0 [0]
Splake	0.0000	0 [0]	0 [0]	0 [0]	0 [0]	0 [0]	9 [7]	0 [0]	9 [7]
Northern pike	0.0034	933 [387]	284 [161]	0 [0]	0 [0]	0 [0]	203 [147]	0 [0]	1,420 [444]
White perch	0.0680	0 [0]	6,005 [3,513]	13,900 [7,116]	6,939 [2,830]	1,455 [446]	175 [175]	0 [0]	28,474 [8,439]
Smallmouth bass	0.0039	0 [0]	273 [204]	521 [224]	32 [32]	479 [304]	345 [185]	0 [0]	1,650 [469]
Yellow perch	0.0333	5,634 [2,136]	709 [654]	2,200 [183]	71 [71]	598 [474]	4,749 [1,859]	0 [0]	13,961 [2,951]
walleye	0.0143	94 [53]	2,004 [802]	893 [253]	946 [393]	1,064 [344]	990 [318]	0 [0]	5,994 [1,041]
TOTAL	0.1877	15,585 [2,333]	10,027 [3,675]	17,845 [7,128]	7,991 [2,858]	3,596 [796]	23,007 [2,305]	544 [115]	78,595 [9,159]
Angler hours		158,851 [13,808]	36,698 [4,613]	30,809 [5,463]	25,310 [4,098]	18,762 [2,335]	142,625 [8,692]	5,745 [777]	418,800 [18,444]

Table 8. Average weight, average length and standard weight of salmonids from Wisconsin's Lake Michigan creel survey, all areas and fishery types combined, 1988-1996. std = standard deviation.

Year	Average weight	± 1 std	Average length	± 1 std	Standard weight
COHO SALMON					
88	4.38927	1.54369	22.4100	2.42620	3.99351
89	4.27399	1.78496	22.5015	2.84274	3.61157
90	4.49193	1.98750	22.6016	3.18498	3.91757
91	4.06888	2.43805	21.6905	3.43957	3.94545
92	4.14931	1.86944	21.9365	3.23596	3.80521
93	3.73333	1.73959	21.2199	2.67736	3.94100
94	3.30836	2.22174	20.1049	3.28443	3.81682
95	3.15977	1.99077	20.3647	3.47945	3.60603
96	4.63768	2.01798	22.5823	3.13583	3.86726
CHINOOK SALMON					
88	11.5957	5.9518	30.0629	6.19946	9.8516
89	9.1850	6.4074	27.4232	6.90950	9.7596
90	9.5136	6.5206	27.6409	7.20534	9.8052
91	8.1385	6.5538	25.7534	6.96827	10.2605
92	10.2518	7.2367	27.9216	7.73204	9.8032
93	10.5038	8.3701	27.4037	8.33738	10.1905
94	10.4453	8.3485	27.0273	8.71924	9.9749
95	9.8882	8.1733	26.3952	8.11261	10.4336
96	8.0482	6.7959	25.7176	7.10989	9.7475
RAINBOW TROUT					
88	6.18994	2.62653	25.4178	4.10865	3.92737
89	6.75515	2.64824	26.6901	3.99997	3.95339
90	6.78511	2.95833	26.2191	4.91875	3.84274
91	6.64343	2.79610	26.3469	4.22405	3.82737
92	7.18517	2.88283	27.0546	4.47526	3.79149
93	6.89070	3.42457	26.2585	4.66549	3.56237
94	6.21323	3.06970	25.5027	4.35808	3.85317
95	6.23276	2.94965	25.4630	4.14715	3.80152
96	6.79034	2.86028	25.8947	4.06373	3.88880
BROWN TROUT					
88	5.50485	2.87826	20.6188	3.94544	4.16698
89	5.49486	2.40390	21.4536	3.25663	4.04284
90	4.96225	2.78125	20.3590	3.76981	4.01236
91	5.11816	2.81203	20.5944	3.39683	4.14541
92	4.39258	2.74944	19.7675	4.06703	3.85596
93	4.82192	2.93521	20.3673	3.98565	3.73331
94	5.57982	3.95542	21.1341	4.70539	3.90347
95	5.27967	3.43907	21.1004	3.92262	3.95885
96	5.53499	3.85055	21.1594	4.26341	3.85055
BROOK TROUT					
88	1.26522	1.11659	13.2891	3.22257	0.97643
89	1.75833	1.52712	15.0167	3.35943	0.92961
90	1.34937	1.49648	13.5329	2.26595	1.02508
91	3.13023	2.88002	17.2930	3.89837	0.73253
92	1.12372	1.28716	12.6987	3.12662	0.86757
93	1.37581	1.36666	13.9435	3.60139	0.87697
94	1.09787	1.21434	12.8191	2.72769	0.89121
95	1.24588	1.03562	12.9365	2.60036	1.03696
LAKE TROUT					
88	8.37042	3.56947	27.5120	3.37376	5.84536
89	8.50272	3.69427	27.8936	3.40782	5.63748
90	8.89295	3.68464	28.1648	3.38979	5.78703
91	9.36891	3.91243	28.5284	3.53048	6.03743
92	9.05581	3.92863	28.6493	3.46747	5.69210
93	7.79163	4.09545	26.8924	3.86344	5.81264
94	7.16244	3.81730	26.3183	4.00574	5.71564
95	8.74280	4.38484	27.3754	3.94920	6.59102

96	7.52374	4.59381	26.3436	4.89904	5.41955
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Figure 1. Geographical area of Wisconsin's share of Lake Michigan.

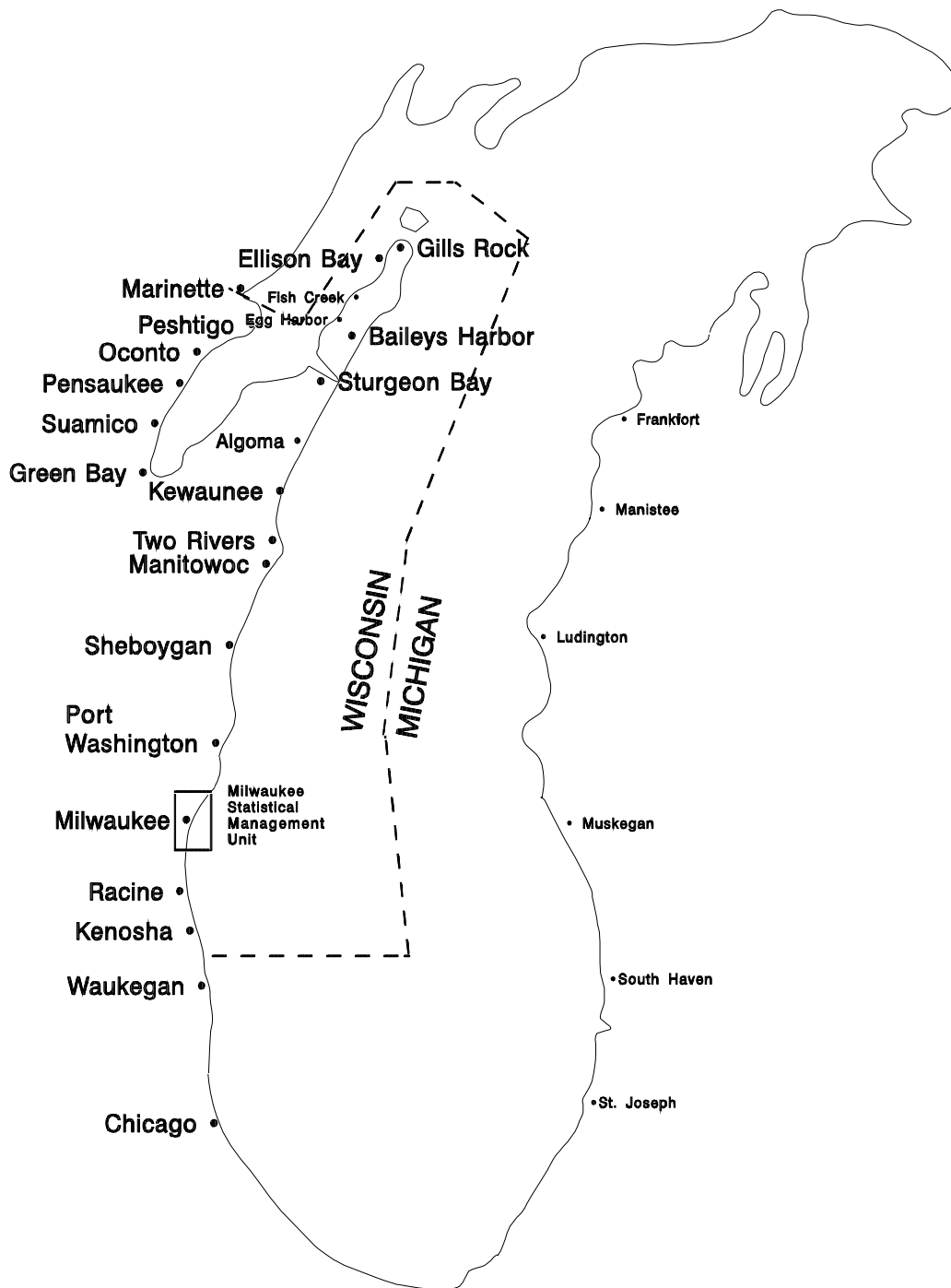


Figure 2. Angler Interview Form.

Figure 3. Catch Record Form.